relate to the calculation of the constants of coils, and the theory of absolute electro-dynamometers and current balances, a domain of the subject to which Prof. Gray has himself so largely contributed. His well-known calculation of the mutual inductance of two single layer coils the axes of which intersect at any angle has led to the realisation of an absolute electro-dynamometer, constructed at the Bureau of Standards, the constant of which can be calculated to a high degree of accuracy. It was shown by Prof. Gray that if the coils of the instrument are concentric and have lengths $\sqrt{3}$ times their radii, all the terms between the first and the seventh vanish in the zonal harmonic series for the mutual inductance and the couple between them, and the remaining terms amount to only a very small correction if the dimensions of the inner coil are small in comparison with those of the outer. Consequently the couple is given very accurately by the first term alone of the series—that is, it can be calculated on the assumption that the inner coil is suspended in a perfectly uniform field equal to the field at the centre of the fixed coil.

It is shown how the values of the mutual inductance of two coaxial single-layer coils (including the important case of a helix and a coaxial circle), the self-inductance of a single-layer coil, and the mutual attraction of two coaxial coils, such as those of a current balance, can also be deduced from the general formula. Many other cases are worked out in the chapter on the calculation of inductances, which is much extended in the new edition, and the description and illustrations of the current balances of the National Physical Laboratory and the Bureau of Standards, and the electro-dynamometer of the latter institution, form a valuable feature of the book.

Other portions of the book which are much expanded are those dealing with magnetometry, measurements in alternating current circuits, the distribution of alternating currents in cylindrical conductors, the comparison of resistances, and the absolute measurement of resistance. The recommendations of the International Conference on Electrical Units held in London in 1908, embodying the definitions of the international ohm, ampere, and volt, and the specification of the Weston normal cell, are given in appendices.

Much that was in the old edition has of necessity been omitted from the new; the omitted portions, however, mainly of a theoretical nature, are not directly connected with methods of measurement, and have been fully treated in Prof. Gray's "Treatise on Magnetism and Electricity." The result is a more complete and a better arranged account of methods of electrical measurement and the calculations connected therewith.

In its new form the book is in one volume, and the larger page, the absence of small type, and the numbered sections will make the book more acceptable to the reader. Typographical errors are remarkably few for a work of this size, and in the few cases where results are stated erroneously (as, for instance, the expression for the capacity of a condenser on p. 749) the reader will find no difficulty in supplying the correction.

Of the great value of the book there can be no question, and it may be confidently anticipated that the new edition will be appreciated as highly as was its predecessor. E. T. J.

The Art of Prehistoric Man.

Prehistory: A Study of Early Cultures in Europe and the Mediterranean Basin. By M. C. Burkitt. Pp. xx+438. (Cambridge: At the University Press, 1921.) 35*s.* net.

DURING the last two decades great progress has been made in our knowledge of prehistoric man, especially by discoveries in the caves of France and Spain. Most of the results are published in technical memoirs in serials not easily accessible, and it is difficult to follow them without much previous study and extensive reading. Mr. Burkitt has therefore done good service by the preparation of his volume on "Prehistory," which summarises the whole subject and enables both the student and the general reader to appreciate its present position. He himself has taken an active part in much of the research, in association with the Abbés H. Breuil and H. Obermaier; he thus writes from personal knowledge, and adds sufficient details of some of the most interesting localities to make his text-book a useful guide for those who wish to visit them.

Other English books, especially those of Lyell and Boyd Dawkins, have already given a good general account of the discoveries of early man in the caves of this country, so that Mr. Burkitt has done well in devoting attention chiefly to France and Spain. His "outline of the history of the subject," however, fails to give due credit to the English pioneers, whose systematic work in Brixham Cave, Kent's Hole, and Wookey Hole is not even mentioned. MacEnery and Pengelly are overlooked, and Mello's discovery of the drawing of a horse's head on a piece of bone from the Cresswell caves is wrongly described, thus throwing doubt on its authenticity. On p. 76 bone is said to have been "first utilised in Upper Mousterian times," and when this statement, based on French and Spanish experience, is contradicted on p. 89 by a casual reference to the English discovery of a large bone implement with early Palæolithic flint implements at Piltdown, the latter is briefly dismissed as "possibly the only exception." England has indeed played a prominent pioneer part in unravelling the problems of prehistoric man, and deserves full acknowledgment.

Mr. Burkitt begins with an excellent concise account of man's relation to the glacial period in western Europe, and shows how far the successive races may be correlated with the mild intervals in this period which are marked by the retreat of the glaciers in the Alps and Pyrenees. He also refers to Baron de Geer's counting of the annual layers of sediment which the ice of the last glacial episode in Scandinavia deposited in the sea during its retreat northwards. From this it is inferred that man cannot have reached southern Scandinavia until it was uncovered twelve thousand years ago. The latest phases farther south in Europe must therefore have been somewhat earlier. How long before the glacial period man first appeared here remains uncertain, but both the Abbé Breuil and Mr. Burkitt are agreed that Mr. Reid Moir's discoveries of worked flints in the Red Crag prove his presence in the Upper Pliocene.

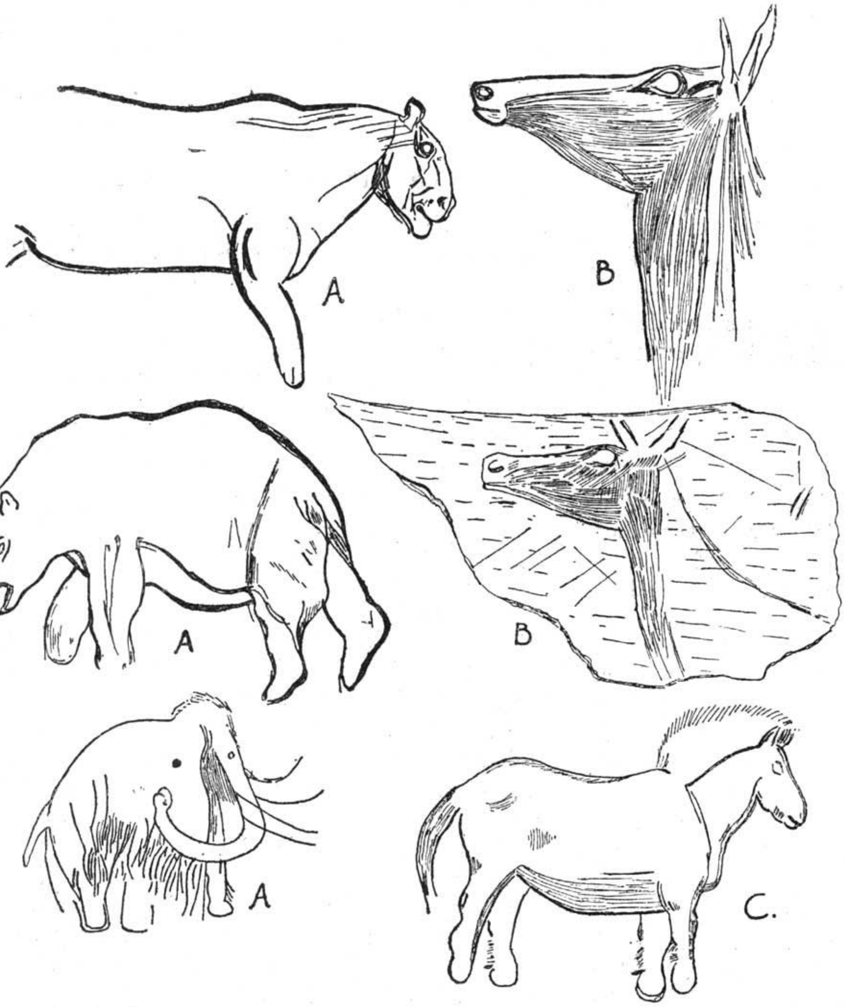

Fig. 1.—Incised drawings rom caves in Dordogne and Cantabria. A. A feline, a bear, and a mammoth engraved on the wall of the cave of Combarelles, Dordogne. B. Head of a deer engraved on the wall of the cave of Castillo, Cantabria, with a similar engraving on a piece of bone from the same cave. C. A hog-maned horse engraved on the wall of the cave of La Pasiega Cantabria. From "Prehistory: A Study of Early Cultures in Europe and the Mediterranean Basin."

Most of the volume is devoted to flint and bone implements and art, and Mr. Burkitt traces the successive developments in a more exhaustive manner than has hitherto been attempted. He classifies the flints, and not only records the order of their succession, but also describes exactly several places of discovery which prove their relative age. He shows how bone harpoons may be treated as fossils, and points out the minute differences which mark the successive periods to which they belong. He also describes palimpsests among the cave-pictures which exhibit the superposition of different styles of art. He is thus prepared to determine the relative age of almost any discovery of prehistoric human handiwork. On the whole the school of "prehistorians" to which he belongs is probably right, but it makes no allowance for sporadic outbursts of genius.

The study of the cave-pictures is especially fascinating, and Mr. Burkitt treats it in great detail. Besides the incised figures on the rock, there are paintings in ochre, oxide of manganese, carbon, and kaolin, all mixed with fat. Those of Palæolithic age are isolated drawings, not grouped in scenes, and the majority are in comparatively inaccessible parts of the caves rather than in ordinary living chambers. They were therefore probably not designed for ornament, but in connection with some ideas of sympathetic magic. "No doubt the wonderful naturalistic animals, sometimes portrayed with the arrows of a hunter in their sides, formed part of a ritual, and were meant to ensure a successful hunt." The incised sketches on bones found in the earth of the floor of the caves were probably in some cases the preliminary studies for the work on the walls and roof.

The volume is illustrated by forty-seven plates, of which we reproduce one (Fig. 1) showing a selection of incised drawings from the caves of Dordogne and Cantabria. All these plates are well described, but they would have proved more useful if they had been referred to in the text. In this and other respects, indeed, the editing of the volume leaves much to be desired, but the work is a unique addition to the literature of prehistoric archæology, and cannot fail soon to reach a second edition, which will afford an opportunity for some useful revision.

A. S. W.

The Science of Ancient Greece.

The Legacy of Greece. Edited by R. W. Livingstone. Pp. xii+424. (Oxford: Clarendon Press, 1921.) 7*s.* 6*d.* net.

THIS book redresses in a remarkable way the injustice done to Ancient Greece in most popular works on the subject. Reference to any short history now in use, such as Bury's, or even to such a fine work as "Hellenica" of the last generation, will show that the author finds "the legacy of Greece" in the city-founding activities of the Greeks, and, above all, in the internecine conflicts of the cities in their prime, with some short reference to the Periclean ideal and the philosophic differences of Plato and Aristotle. There is little about literature, less about art, and nothing at all about science. Mr. Livingstone, in planning this volume, has deliberately and rightly set himself to correct this and to put the really substantive achievement of the Greeks in the realm of thought in its due place. The result is that a good third of the book is given to science, and if we include Prof. Burnet's article on Philosophy, which shows its connection with science, we get a larger proportion still. It is most welcome evidence of a change of mind in the university which stands more than any other among us for Greek studies.

The effect is amazing to those accustomed to the old and mainly political outlook, and it will be very wholesome. We see that in every branch of science, in biology and medicine as much as in mathematics, the Greeks laid the foundations on which mankind has built ever since. Sir T. L. Heath well brings this out in his article on Mathematics and Astronomy, which is a complete review of the Greek work from Thales to Diophantus; while Dr. Singer is equally full on Biology and Medicine. The reader will probably share one impression which was borne in strongly on the present reviewer. The writers who describe the newly admitted branches of the legacy of Greece are so full of their subjects, and so eager to display their richness and wonders, that their essays suffer somewhat in comparison with those which deal more allusively with the more familiar topics. Hence the most readable papers, which leave the clearest impression, are Prof. Burnet's on Philosophy, Mr. Livingstone's on Literature, and Mr. Percy Gardiner's on "The Lamps of Greek Art." These are altogether admirable; the leading features are emphasised, and no attempt is made to be exhaustive.

But the fault—if it be a fault—in the essays on science is entirely in the right direction. We have here for the first time in a compendious form the main steps of the Greek construction in mathematics, astronomy, biology, and medicine, and the book is well worth buying for this part of it alone. A charming essay by Prof. D'Arcy Thompson on the Science of Aristotle adds to the attractiveness of the volume, but somewhat disturbs the balance of Dr. Singer's excellent articles on biology and medicine as a whole.

The supreme merit of the book is that it puts in unmistakable prominence the intellectual quality of the Greek mind in its prime, its desire to know, and its power of arranging the material it acquired in that connected form which we call scientific. This is equally salient on the mathematical and the biological side. Sir T. L. Heath shows us how the Greek philosophers had quite early hit on the fundamental equations in geometry; within the seven hundred years of their flourishing they had founded trigonometry through the necessities of their astronomy, anticipated the integral calculus by their method of exhaustions, and laid the basis of algebra in the first generalised notation of Diophantus. In the sciences of life Aristotle had given the first rational classification of living things and an incomparable mass of faithful and detailed description; while the sound principles of Hippocrates in the fifth century in tracing health and illness to natural causes were far in advance of medical theory and practice until the revival of science a thousand years later. It is by these achievements, more than by any other, that the Greeks still rule us from their tombs, and we are deeply grateful to Mr. Livingstone and his coadjutors for putting them in such a clear light without ignoring the due proportion of political theory, art, and psychological philosophy. The well-chosen illustrations add greatly to the value of the volume.

F. S. MARVIN.